

11/06/02

1 of 1

Supersedes Suppl. Spec. dated 3/8/99, 6/11/1999, 10/8/99, 4/21/00, 11/3/00, 02/07/02, 04/04/02, 06/10/02, 09/04/02

SUPPLEMENTAL SPECIFICATION

AMENDMENT TO SECTION 520 -- PORTLAND CEMENT CONCRETE

Amend 1.1 to read:

1.1 This work shall consist of furnishing and placing portland cement concrete of the classes specified including fly-ash, silica fume, or ground granulated blast furnace slag as shown on the plans or ordered.

Amend to Table 1 - Classes of Concrete (Metric) to read:

Table 1 - Classes of Concrete

Concrete Class	Minimum Expected 28 Day Compressive Strength ¹	Maximum Water/Cement Ratio ²	Entrained Air Percent
MPa (PSI)			
AAA ³	35 (5,000)	0.400	5 to 8
AAA	35 (5,000)	0.444	5 to 8
AA ³	30 (4,000)	0.400	5 to 8
AA	30 (4,000)	0.444	5 to 8
A ³	20 (3,000)	0.400	4 to 7
A	20 (3,000)	0.464	4 to 7
B	20 (3,000)	0.488	3 to 6
T	20 (3,000)	0.559	----
F	0.2 (30) ⁴	3.0 to 4.0 ⁵	15 to 25 ⁵

Delete Table 1E - Classes of Concrete (English)

Amend Footnotes to read:

¹ See 3.1.6 TESTING

² For mixes containing fly-ash, silica fume, slag, or any other pozzolanic or cementitious material, the water/cement ratio of the concrete mix shall be based on the water cementitious (cement + pozzolanic or cementitious material) ratio of the mix. This water to cementitious ratio shall not exceed those listed in Table 1. The maximum water/cement ratios listed for Concrete Class B and T are for design purposes only.

³ When high range water reducing admixture is specified.

⁴ **Maximum** 84 day Compressive Strength for Flowable Fill, Excavatable shall not exceed 1.4 MPa (200 psi).

⁵ These are recommended values that may be used as a starting point for a mix design that has shown ability to meet the requirements. The amount of cement shall be adjusted and fly-ash or ground granulated blast furnace slag shall be used in the mix design in accordance with 2.11.1.

Add to 1.2.1:

(f) Class F, Flowable Fill, Excavatable may be specified or requested in writing as a substitute for compacted gravel in embankment, granular backfill, structural fill, and pipe backfill. Approval in the form of a supplementary agreement shall be in consideration of, but not limited to, differential frost heaving due to dissimilar materials, unit weight structural requirements, lack of permeability, and damming resulting from water flow cut off. Flowable fill will not be allowed in lieu of pavement. Class F, Flowable Fill shall be a flowable, self-consolidating, rigid setting and low density material.

(g) Precast concrete shall be Class AAA.

Add to 2.2.2.

2.2.2.3 The requirements of 2.2.2.2 will not apply to fine aggregate for concrete class F, flowable fill. For concrete class F the fine aggregate grading shall be submitted with the mix design.

Add to 2.3:

2.3.7 Silica Fume shall conform to AASHTO M307, Microsilica for use in Concrete and Mortar.

2.3.7.1 Bags used to supply silica fume shall not be incorporated into the concrete.

Amend 2.2.4.1 to read:

2.2.4.1 Fly-ash shall normally conform to Class F as described in AASHTO M 295 and shall meet the requirements of 2.2.4.3. Ground Granulated Blast Furnace Slag (GGBFS) shall be Grade 120 slag meeting the requirements of AASHTO M 302.

Delete 2.2.4.2

Delete 2.2.4.5

Amend 2.2.4.1.1 to read:

2.2.4.2 Only one source of fly-ash or ground granulated blast furnace slag shall be used on any one project.

Add to 2.6:

2.6.4 Cotton mats shall consist of a filling material of cotton "batting" (minimum 400 grams/square meter); covered with unsized cloth (minimum 200 gram/square meter); tufted or stitched to maintain stability. Mats shall be free from tears; and shall be in good condition.

Amend 2.11.1 to read:

2.11.1 The concrete mix shall be composed of a mixture of aggregate, cement, fly-ash or ground granulated blast furnace slag, water, and chemical admixtures as required. All concrete mix designs shall substitute a minimum of either 25% fly-ash or 50% ground granulated blast furnace slag for cement by weight. Except for concrete class F, the several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mix meets the grading requirements of Table 4 or Table 5.

Amend the first sentence of 2.11.2 to read:

2.11.2 The concrete mix design limits given in Table 4 or Table 5 indicate the master ranges of all mixes except concrete class F, permissible under these specifications.

Add to 2.11.2:

2.11.2.4 Alternate mix designs for excavatable flowable fill and other categories of flowable fill, will be allowed, providing the mix design for each is approved by the Bureau of Material and Research. Other categories of flowable fill might include non-excavatable, ultra-light weight, very flowable or other combinations. Alternative flowable fill mix designs would be used when specified or ordered. All mix designs submitted for approval shall be accompanied by 5 test cylinders, which will be used to determine compressive strength, unit weight and excavatability. Test cylinders will be evaluated at 84 days. Compressive strength test cylinder will be prepared according to ASTM D 4832, as modified by NHDOT Test Procedure P-2.

Amend Table 3:**Table 3 - Coarse Aggregate**

Class of Concrete	A ¹ , B, and T	A, AA, and AAA	Overlay
Standard Stone Size	467	67	89
Nominal Size	37.5 to 4.75 mm (1 ½" to No. 4)	19.0 to 4.75 mm (¾" to No. 4)	9.5 to 1.18 mm (3/8" to No. 16)
SIEVE SIZE	PERCENTAGE BY WEIGHT PASSING		
50 mm (2")	100		
37.5 mm (1 ½")	95 - 100		
25.0 mm (1")		100	
19.0 mm (¾")	35 - 70	90 - 100	
12.5 mm (1/2")			100
9.5 mm (3/8")	10 - 30	20 - 55	90 - 100
4.75 mm (No. 4)	0 - 5	0 - 10	20 - 55
2.36 mm (No. 8)		0 - 5	5 - 30
1.18 mm (No. 16)			0 - 10
0.300 mm (No. 50)			0 - 5

Delete Table 3E:**Amend 2.11.2** to read:

The Contractor shall submit a mix design appropriate for the raw materials and blends of approved aggregates available for the specific project. The concrete mix design limits given in Table 4 or Table 5 indicate the master ranges of mixes permissible under this specification. The mix design shall be within the master ranges indicated for the particular class of concrete specified. The mix design for each mix shall establish a single percentage of aggregate passing each required sieve size in accordance with Table 4 and Table 5, a cement factor and a water cement ratio as shown in Table 1. Gradings which range from the maximum of one sieve size to the minimum of the next will not be permitted. No concrete placement shall be started on a Project until the Bureau of Materials and Research has approved the mix design for that placement. The mix design for each mix shall be in effect until modified in writing by the Bureau of Materials and Research.

Amend 2.11.2.1 to read:

Should a change in sources of material be made, a new mix design shall be submitted per 2.11.2. When unsatisfactory results or other conditions make it necessary, the Engineer may establish a new mix design.

Amend Tables 4 and 5, to read:**Table 4 - Coarse Aggregate with Specific Gravity Less Than 2.700**

Sieve Size	Concrete Classes* A ¹ , B, and T			Concrete Classes** A, AA, and AAA		
	Mi n.	Desired	Max.	Min.	Desired	Max.

	(PERCENT BY WEIGHT PASSING)			(PERCENT BY WEIGHT PASSING)		
37.5 mm (1 ½")	95	100	100			
25.0 mm (1")		80			100	
19.0 mm (¾")	56	68	80	94	97	100
12.5 mm (½")		57			77	
9.5 mm (⅜")	38	46	55	51	62	73
4.75 mm (No. 4)	31	35	39	37	42	47
2.36 mm (No. 8)		29			34	
1.18 mm (No. 16)	16	23	30	19	27	35
0.600 mm (No. 30)		14			17	
0.300 mm (No. 50)	4	7	10	4	8	12
0.150 mm (No. 100)	1	2	3	1	2	4
0.075 mm (No. 200)	0	0	2	0	0	2

Delete Table 4E:

Table 5 - Coarse Aggregate with Specific Gravity 2.700 and Over (Metric)

Sieve Size	Concrete Classes* A ¹ , B, and T			Concrete Classes** A, AA, and AAA		
	Mi	Desired	Max.	Min.	Desired	Max.
	n. (PERCENT BY WEIGHT PASSING)			(PERCENT BY WEIGHT PASSING)		
37.5 mm (1 ½")	97	100	100			
25.0 mm (1")		83			100	
19.0 mm (¾")	57	69	82	95	97	100
12.5 mm (½")		61			81	
9.5 mm (⅜")	45	52	59	55	65	76
4.75 mm (No. 4)	36	40	44	42	47	53
2.36 mm (No. 8)		34			40	
1.18 mm (No. 16)	20	27	35	22	31	40
0.600 mm (No. 30)		17			19	
0.300 mm (No. 50)	4	8	12	5	9	14
0.150 mm (No. 100)	1	2	4	1	2	4
0.075 mm (No. 200)	0	0	2	0	0	2

* Class A¹, B, and T based on fine aggregate content of 38 to 42 percent of the total aggregate.

**Class A, AA, and AAA based on fine aggregate content of 44 to 48 percent of the total aggregate.

¹ See footnote to Table 3.

Delete 2.11.4

Delete 2.11.4.1

Delete 2.11.4.2

Amend 3.1.1.6 to read as follows::

3.1.1.6 The ratio of substitution of cement to fly-ash or cement to ground granulated blast furnace slag shall be 1:1 by weight. Substitution of fly-ash or ground granulated blast furnace slag shall not be made for blended cements.

Amend 3.1.3.2.1 to be 3.1.3.3.

Add to 3.1.3:

3.1.3.4 Testing equipment shall be calibrated by the Contractor in accordance with 106.03.

Add to 3.1.6.1:

3.1.6.1.1 For concrete class F, flowable fill cylinders for compressive strength tests will be prepared when required in accordance with ASTM D 4832 as modified by NHDOT Test Procedure P-2.

Add to 3.1.6:

3.1.6.3 Unit weight shall be determined in accordance with AASHTO T 121.

Amend 3.2.1 to read:

3.2.1 Drawings and data for falsework shall be submitted for documentation in accordance with 105.02. A concrete density of 2,400 kg/m³ (150 lb/ft³) and a live load of 245 kg/m² (50 lb/ft²) shall be used in calculations. Adequate provisions shall be made for the effect of vibration and impact on the forms and falsework.

Add to 3.5.1:

3.5.1.5 When concrete is to be placed against granite bridge curb, the granite curb shall have been kept continuously wet for a period of 12 hours before coming into contact with the fresh concrete. Care shall be taken when removing soaking material to insure that the curbing remains wet until the fresh concrete is placed against it. Any standing water shall be removed before the concrete is placed.

Add to 3.5.3

3.5.3.7 Means to contain concrete class F, flowable fill within a designated space shall be provided. Approved methods to prevent pipes from floating during placement of concrete shall be used.

3.5.3.8 Concrete class F, flowable fill shall be left undisturbed until the material obtains sufficient strength to support the weight of foot traffic without deformation for earthen back fill operations or vehicle traffic for paving operations.

Add to 3.5.4:

3.5.4.4 No consolidation or vibration of concrete class F, flowable fill is required.

Amend 3.9.1 to read:

3.9.1 Surfaces Other Than Concrete Decks and Approach Slabs (at grade).

Amend 3.9.2 to read:

3.9.2 Concrete Decks and Approach Slabs (at grade).

Amend 3.9.2.1 to read:

3.9.2.1 All concrete decks and approach slabs (at grade) shall be finished with the use of an approved finishing machine, capable of adjustment for crown and width, and capable of raising the screeds to clear the concrete when required unless specific written permission is given for an alternate method.

Amend 3.9.2.5 to read:

3.9.2.5 The finished concrete shall have the required crown and grade and the surface shall not vary from either by more than 3 mm in 3 m (1/8 in. in 10 ft). The surface shall have a concrete surface profile (CSP) of 5 or less in accordance with the International Concrete Repair Institute (ICRI) technical guideline for "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays" Guideline No. 03732. As soon as the bleeding has stopped or the sheen has started to disappear, the concrete shall be given a final surface finish by scraping or dragging with an approved float at least 900 mm (3 ft) in length. The float shall be placed on the outer edge of the finished concrete and moved transversely the full width of the deck. The finished edge shall be parallel to centerline. Each subsequent pass shall lap the preceding pass by at least 1/2 the length of the float. Concrete decks that will be the final wearing surface shall receive a pan drag without a float finish. This shall be followed by a broom finish utilizing a broom specifically made for this purpose. Fabric impressions in the surface caused by the texture of water-retaining materials shall not be cause for rejection. Objectionable defects, such as sharp edges caused by cement cream lines or fabric creases, shall be removed by the Contractor.

Delete 3.9.2.6

Amend 3.10.1 to read:

3.10.1 All exposed surfaces of concrete except Class F, Flowable Fill shall be cured for a minimum of seven days in accordance with the requirements of Table 7. All water used to wet cure concrete shall conform to 2.5.

TABLE 7 - CONCRETE CURING

Type of Construction	Curing Method	Minimum Number of Days Before Membrane Application	
		Horizontal	Vertical
Bridge Decks and approach slabs	c	14	14
Concrete to be treated w/ Item 534 or 537	a		
All other concrete except Class F, Flowable Fill	a or b	14	7

Cure Method “a” - Concrete shall be kept moist until it can support curing covers at which time it shall be completely covered with a vapor-proof barrier conforming to 2.6.2. Water shall be reapplied as necessary to keep the surface of the concrete wet for the entire 7 day cure period.

Cure Method “b” - Immediately after finishing, all exposed surfaces shall be treated with a liquid curing compound conforming to 2.6.3 at the rate of 2 liters per 10 square meters (1 gallon per 200 square feet) or by fog spray, sprinkling or ponding of water conforming to 2.5 or any combination of the above, when the weather permits. Within 24 hours of finishing, these surfaces shall be completely covered with a vapor-proof barrier conforming to 2.6.2 for the remainder of the 7 days.

Cure Method “c” - The surface shall receive a wet cure utilizing water retaining material for at least 7 days. Water retaining material shall be burlap conforming to 2.6.1, cotton mats conforming to 2.6.4 or other approved water retaining material. Water retaining material shall be kept wet for the entire seven days. Apply water retaining material in accordance with 3.10.3. During the first 24 hours, the water retaining material shall be kept continuously wet by means of an approved automatic sprinkling or wetting system. After 24 hours, the Contractor may cover the wet water retaining material with a 0.1 mm (4 mil) minimum white polyethylene film for the remainder of the curing period in lieu of using a sprinkling or wetting system although wetting under the polyethylene may be required. Failure to cure concrete by an approved method shall be cause for rejecting the work.

Amend 3.10.2 to read:

3.10.2 When curing concrete with fly-ash or ground granulated blast furnace slag, the 7 day curing period specified in 3.10.1 shall be extended, if necessary, to assure the concrete attains the design strength.

Delete 3.10.2.1 through 3.10.2.4

Add to 3.10:

3.10.3 Application of Water Retaining Curing Material.

3.10.3.1 Burlap shall be applied damp within 30 minutes after concrete has been finished.

3.10.3.2 Cotton mats shall be applied dry within 10 minutes after concrete is finished and saturated immediately after. Care shall be exercised to ensure that the cotton mats are weighted down adequately to provide continuous contact with the concrete surface.

3.10.3.3 Other approved water retaining curing material shall be applied in accordance with the manufacturers recommendations and as approved by the Engineer. **Amend** 3.11.1.1 to read:

3.11.1.1 Unless otherwise permitted, load bearing forms may not be removed until concrete test cylinders have attained 80 percent of the specified design compressive strength. If not controlled by such tests, the following periods may be used as a guide: For deck slabs, centering, and falsework, 14 days; for all other parts, 3 days or as directed. Non-load bearing forms may be removed in order to finish the concrete surface following a minimum 24 hours cure time, when directed by the Engineer.

Add to 3.11.2:

3.11.2.2 The peak particle velocity ground vibration limits adjacent to newly placed concrete as specified in 203.3.2.5.1.5 shall apply.

Amend 3.11.2.1 to read:

3.11.2.1 Nothing, except as permitted in 3.10.1, shall be placed on the concrete prior to the minimum time periods specified in Table 8.

TABLE 8 - CONCRETE LOADING

Type of Construction Minimum Requirements before Loading after
Placement of Concrete

Substructure concrete including footings	80% of design strength or 7 days
Box culvert base slabs	5 days
Superstructure concrete	- 3 days and 15 MPa (1,800 psi) for curb placement; - 80% of design strength for light vehicular loads when permitted
	- 14 days and 20 MPa (3,200 psi) respectively for

- membrane and paving placement; and
 - 30 MPa (4,000 psi) for legal traffic loads
-

Amend 3.12 to read:

3.12.1.2. Forms may be removed in accordance with 3.11.1.1. If the required curing period has not been completed for a surface being finished, only the portion of the surface actually being finished shall be exposed, and curing will be immediately re-established once the phase of finishing underway has been completed.

All exposed concrete surfaces shall be given a Class 1, Ordinary Finish. If a Class 2 or other finish is required, it shall be as specified by the Plans, Supplemental Specifications, or Special Provisions for designated surfaces.

3.12.1.3 Class 1, ordinary finish. Fins and projections shall be removed from all surfaces except those which will not be exposed. On all exposed surfaces the cavities produced by form ties, honeycomb spots, broken corners or edges, and all other holes and defects shall be thoroughly cleaned and saturated with water for not less than 3 hours. These areas shall then be carefully pointed and trued with a mortar composed of the same brand of cement and fine aggregate mixed in the proportions of the concrete being finished. Mortar used in pointing shall not be more than 1 hour old. The mortar patches shall be cured as specified in 3.10. All expansion joints in the completed work shall be left carefully tooled and free of mortar. The joint fillers shall be left exposed for their full length with clean, true edges. Holes which will not be exposed, may be filled with asphalt cement when permitted.

3.12.1.4 Class 2, rubbed finish. After removal of forms, holes and imperfections shall be filled with mortar conforming to 3.12.1.3. After the mortar has thoroughly set, the concrete shall be saturated with water for at least 3 hours. The concrete shall be kept continuously wet at all times during finishing. The surfaces shall then be rubbed with a medium coarse Carborundum stone and a small amount of mortar until all voids have been filled and all marks and projections have been removed and the surface is uniform. This surface shall be left until all concrete to be rubbed above it has been similarly treated.

3.12.1.4.1 After all concrete surfaces have received their initial rubbing, the next procedure shall consist of rubbing the concrete with a fine Carborundum stone and water until a smooth uniform texture is obtained.

3.12.1.4.2 The final procedure shall consist of rubbing the concrete with dry burlap to remove loose powder. Should the final surface be unsatisfactory, a repetition of the above procedures will be required. The final surface shall have been achieved by altering the original concrete surface; a surface coating of cementitious material which adds thickness to the original surface is not acceptable.

Amend 4.1 to read:

4.1 Concrete class AAA, AA, A, B, T and F will be measured by the cubic meter (cubic yard) in place unless otherwise indicated, and in accordance with the following.

Add to 4.1.1:

4.1.1.3 Concrete Class B, footings (on rock) will be measured to the form lines placed at the limits shown on the plans. All concrete class B, footings (on rock) where rock will not be removed shall be formed and measured in accordance with 4.1.1.2.

Amend 4.2 to read:

4.2 Concrete class AAA, AA;; A, above footings; A, culverts; B, footings (on soil) and concrete bridge deck of the type specified will not be measured, but shall be the cubic meter (cubic yard) final pay quantity in accordance with 109.11 for material required within the limits shown on the plans.

Delete 4.2.1 and 4.2.1.1.

Amend 5.1 to read:

5.1 The accepted quantities of concrete class AAA, AA, A, B, T and F will be paid for at the contract unit price per cubic meter (cubic yard) complete in place, unless otherwise indicated.

5.1.1 The cost of development and testing of alternate mix designs for concrete class F, flowable fill will be subsidiary to the item.

Amend 5.2 to read:

5.2 Concrete class AAA, AA;A, above footings; A, ; A, culverts; B, footings (on soil) and concrete bridge deck of the type specified are final pay quantity items and will be paid for at the contract unit price per cubic meter (cubic yard) in accordance with 109.11.

Add to Pay items and units:

520.001	Concrete Class AAA	Cubic Meter (Cubic Yard)
520.03	Concrete Class AA	Cubic Meter (Cubic Yard)
520.211	Concrete Class B, Footings (On Rock)	Cubic Meter (Cubic Yard)
520.213	Concrete Class B, Footings (On Soil) (F)	Cubic Meter (Cubic Yard)
520.421	Concrete Class F, Flowable Fill, Excavatable	Cubic Meter (Cubic Yard)

Amend the following Pay items and units:

520.__	Concrete Class __, _____ (F)*	Cubic Meter (Cubic Yard)
520.12	Concrete Class A, Above Footings (F)	Cubic Meter (Cubic Yard)
520.7	Concrete Bridge Deck (F)	Cubic Meter (Cubic Yard)

* Some of these items may not be a final pay quantity item.